Synthesis of Written and Oral Comments on Demolition and Disposal of Hurricane Debris (Draft 1, 10-04-05)

Format for This Synthesis:

This synthesis lists the documents provided and reviewed, states the background and charge questions given by the U.S. EPA Office of Compliance and Assurance, and offers non-consensus written and oral comments provided by the panel both of a general nature and specifically to each of the five charge questions.

The written comments submitted prior to the conference call are appended as submitted by the panelists.

Where applicable, the panelist's name is given in parentheses so that the offered comment can be ascribed.

Documents Reviewed:

1. Charge Questions for SAB Workgroup Consultation on Approach for Conducting Source Emission Characterization Tests of Open Burning of Vegetative and Demolition Debris (10/3/05 version).
2. EPA's Conditions for Granting a No Action Assurance and Associated Recommendations for LDEQ Asbestos Demolition and Disposal Procedures for Jefferson Parish, Orleans Parish, Plaquemines Parish and St. Bernard Parish in the Aftermath of Hurricane Katrina and Hurricane Rita (10/3/05 draft).
3. Appendix A to Document 2: Hurricane Katrina Debris Management Plan, Louisiana Department of Environmental Quality, September 28, 2005, Revised September 30, 2005.
4. Appendix B to Document 2: Approach for Conducting Source Emission Characterization Tests of Open Burning of Vegetative and Demolition Debris.
5. Appendix C to Document 2: Air Monitoring Contingency Plan for Hurricane Katrina Debris Activities Louisiana (September 2005).
6. Appendix D to Document 2: Overview Plan for Ambient Air Monitoring after Hurricane Katrina.
7. Letter of September 22, 2005 from LDEQ to Region 6.

Overview and Charge Questions from the U.S. EPA Office of Enforcement and Compliance Assurance:

In the aftermath of Hurricane Katrina and Hurricane Rita, and the subsequent flooding, EPA has been asked by the Louisiana Department of Environmental Quality (LDEQ) to review their approach for addressing demolition and disposal of specific structures in Jefferson Parish, Orleans Parish, Plaquemines Parish and St. Bernard Parish. EPA intends to exercise its enforcement discretion and grant a no action assurance for demolition and disposal of asbestos-containing waste material in these parishes provided

those activities are carried out in accordance with the LDEQ guidelines and the conditions set forth in a guidance document entitled "EPA's Conditions for Granting a No Action Assurance and Associated Recommendations for LDEQ Asbestos Demolition and Disposal Procedures for Jefferson Parish, Orleans Parish, Plaquemines Parish and St. Bernard Parish in the Aftermath of Hurricane Katrina and Hurricane Rita" (Conditions and Recommendations Document) The conditions and recommendations were developed for the purpose of minimizing any potential adverse public health and environmental effects from the demolition and disposal activities. This no action assurance will extend for a period of six months from the date of the transmittal letter. Prior to the expiration date, the situation will be reviewed to determine if either the guidance or the no action assurance needs to be modified or revoked.

Note that within the Conditions and Recommendations Document, the Air Curtain Destructor (ACD) section provides a process for ACD operating parameters to be determined through an approach described in Appendix A, entitled "Approach for Conducting Source Emission Characterization Tests of Open Burning of Vegetative and Demolition Debris." We are interested in learning whether this approach will allow us to verify the effectiveness of this process in reducing potential risks from use of ACD technology. To this end, we are asking the Science Advisory Board to answer the following questions:

1. Open burning issues of concern

The approach identifies several issues of concern associated with open burning:

Failure of asbestos to be transformed into benign forms
Emissions of metals, particularly lead and mercury
Formation of halogenated organic compounds
Increased emissions of PM, including $PM_{2.5}$

Are these the situations that should most receive attention?

2. Parameters to be monitored

Are the parameters that are described adequate for developing operating guidance to ensure that future open burning activities are conducted in such a way to minimize adverse impacts on human health and the environment?

3. Pollutants to be measured

Given the broad range of compounds likely to be present in open burning of demolition debris, do the specific compounds listed describe an adequate range of pollutants to provide guidance on the performance of open burning systems?

4. Burn site monitoring – continuous monitoring or characterization monitoring

Is it sufficient to monitor an initial burn(s) to develop a characterization of potential releases rather than continuously monitoring each burn? How many burns

should be monitored to develop the initial characterization necessary to determine the appropriate parameters?

5. Monitoring methods, equipment, and quality assurance activities

To the extent that EPA has been able to describe or reference the monitoring methods, equipment, and quality assurance activities in the document, are they appropriate? What advice do you have for EPA as we further develop the methods and equipment plans?

General Comments from the Panel:

Clarify, where applicable, the use of firebox ACDs, pit ACDs and open pile burns (Eighmy).

Clarify how open pile burning and ACDs will be generally used (Eighmy).

If appropriate, EPA and LDEQ might make use of sampling methodologies and device configurations in the ___ and ____ as sampling plans are finalized (Eighmy).

Simplify the program by restricting the burning of building debris to only pit ACDs and firebox ACDs (Eighmy).

Simplify the program by doing duplicates initially. You can always go back and add to the program later once more information is available. It is going to be tough to even make the duplicates truly duplicate in nature (Eighmy).

Simplify the program by doing using only one type of composite demolition waste initially. You can always go back and add to the program later once more information is available (Eighmy).

Give some thought to designing a subsequent side study that looks at ACD operation (bed layering, percent over fire air, transient emissions when debris is charged and the curtain is temporarily breeched) once initial information is obtained (Eighmy).

My major concern is the potential differences between the operation of systems in test burns and demonstration combustion projects and mass production efforts. It is one thing to set up the air curtain combustor when you know you are being watched with a careful monitoring effort. It is quite possible to be less careful when you are combusting material day-after-day-after-day on different sites and with different mixes of input materials. It is not clear from the documents what the continuing level of oversight and monitoring. Given the staggering amount of material to be inspected and disposed of, there will need to be a large number of monitoring and oversight personnel assigned to ensure that the procedures are being followed each and every time and that the ACD is being properly used as it is moved on a frequent basis. (Hopke)

Charge Question 1. Open burning issues of concern:

I have serious reserves concerning the use of open burning for cleanup of hurricane-related debris. Open burning does not effectively destroy existing toxic chemicals, and it forms new toxic chemicals. Biomass combustion emissions are not that different than emissions from smoking a cigarette except that they do not contain high levels of nicotine. (Dellinger)

The volumes to be burned are enormous and the combustion control is poor. Emissions will likely be overwhelmingly larger than from existing municipal or hazardous waste incinerators in the US. Incinerators have been largely eliminated as a result of public concern, and they are much better controlled than open burning. Is there any real data to suggest that air curtain burning is any better? (Dellinger)

There is a lot of support for coastal restoration in Louisiana. Can the debris be used for this purpose? If transport of Formosan termites is a concern, the debris could first be treated then transported. (Dellinger)

Transporting the debris to "rural" areas brings up environmental justice concerns. The inhabitants of the rural areas did not generate the debris, so why should they be exposed? Even if the population density is lower in a rural area, exposed people are still exposed to the full dose of pollution. Either burn the debris in place while no one is still in New Orleans, burn it on the coast while the winds blow into the Gulf, or better yet, burn it in an incinerator. (Dellinger)

This is a good list to start with and includes contaminants of concern. I wonder how easy it will be to relate burner type and waste type to something like standardized emissions or emission factors for these materials (Eighmy).

There is some literature on the dehydroxylation of chrysotile to forsterite at temperatures above 800^{o}C and at ambient pressure (e.g., MacKenzie and Meinhold (1994) Amer. Mineral. 79:43-50, Jeyaratnam and West (1994) Ann. Occupational Hygiene 32: 137-148). There is less know about the kinetics of the reaction, though one source reports the reaction is fast. The time/temperature/turbulence conditions in the ACDs are not well known and the ability to sample for flue gas particles that may contain chrysotile or its thermal degradation products is important. Likewise, sampling the bottom ash would also be important. Depending on the type of waste burned and the asbestos level, finding particles may be like finding needles in a haystack. Consider some additional bulk techniques as a screen first (especially x-ray diffraction). The TEM technique can then be made easier to use if you can concentrate the chrysotile/forsterite samples through some technique (perhaps washing, density gradient separation, magnetic separation) (Eighmy).

Given the highly heterogeneous nature of the materials being burned, I would worry about the uniformity of temperature and thus, would not assume that all of the chrysolite will be converted into forsterite. Although the guidelines call for the mean temperature to remain above 800C, it is certainly possible to have areas that do not consistently meet

that temperature while other regions are higher. Thus, the assumption should be made that there will remain chrysolite in the debris. (Hopke)

Issues of concern that should receive as much, or more concern than the four ones listed are:
* mold spore dispersion and worker exposures in handling waste construction debris
* are wastes sufficiently segregated prior to combustion
* how will burn temperature be maintained when burning construction debris in view of non-combustibles and varying moisture content?
* how will burn temperature be maintained when burning vegetative debris in view of varying moisture content?
* will the burn temperature be optimal or nearly so for minimizing the formation of halogenated organic compounds?
* will air quality data from early burns be available in time to influence protocols for subsequent burns? The asbestos issue is broader than the thermal conversion of chrysotile to forsterite. The protocols fail to address the possible presence of more the hazardous amphibole fibers. Also the analytical protocols indicate that AHERA counting rules would be used, which will ensure that the fiber counts are dominated by fibers shorter than 5 um, which pose negligible risks. (Lippmann)

The heterogeneity of the waste's heat content and composition and the heterogeneity of the burning conditions are more diverse in the air curtain pit burners than exists for municipal solid waste incinerators. Care needs to be taken by the operators to provide adequate mixing of the wastes to achieve a more uniform temperature and reasonable circulation of combustion air. A wide range of contaminants is proposed to be monitored, but it is unclear how well the results will characterize the bottom ash, fly ash, and gaseous emissions. It would be good to consider how the monitoring results will provide feedback to the community and to the personnel operating the burn site. The documentation should also provide guidelines about when to burn that are based on meteorological conditions (e.g. existence of low lying inversion layers, wind direction/speed, and select atmospheric stability conditions). Dispersion modeling scenarios should be considered to provide the operators the best conditions to complete the burns. (Rood)

The documentation takes into special consideration: 1) asbestos, 2) metals, particularly lead and mercury, 3) halogenated organic compounds, and 4) PM, including PM2.5. However inorganic gases such as HCl and CO should be carefully monitored to characterize acid gas emissions and incomplete combustion. Production of these contaminants during stable atmospheric conditions could prove problematic for nearby burn pit operators and communities. (Rood)

Charge Question 2. Parameters to be monitored: Are the parameters that are described adequate for developing operating guidance to ensure that future open burning activities are conducted in such a way to minimize adverse impacts on human health and the environment?

It is not clear that a test burn to determine safety is being proposed. It appears that all the monitoring is to be conducted while the actual burn is being conducted. I strongly recommend a well documented and monitored test burn be conducted and evaluated before actual burns are conducted. (Dellinger)

Open burning is impossible to control. Temperature measurements will have little meaning as the temperature will vary widely. Toxic chemicals will be vaporized ahead of an advancing flame front and may be vaporized rather than burned. The burn guidelines state that a minimum temperature of 800 C must be maintained. This is very low and will not destroy most chemicals under sub-stoichiometric combustion conditions. Normal temperature fluctuations will result in the temperature being too low to destroy most toxic chemicals even under oxidative conditions. (Dellinger)

The air emission and residual sampling campaign must be made as uniform and standardized as possible across the range of waste combusted and combustor types. That will require some knowledge of the fuel, the combustor air provision (where possible) and combustor burn performance (% O_2, CO, CO_2). This is not simple given the notion of sampling an open burning pile, unconfined combustion generally even in an ACD, and the spatial-temporal nature of the combustion flame even in an ACD (Eighmy).

Most ACDs have somewhat steady state operations intermixed with transient loadings that can breech the air curtain. Some understanding of what is emitted during breech events may eventually be helpful. (Eighmy)

The procedures outlined seem very reasonable, but it is of great concern that in a mass production operation that will require the use of far more people than currently have experience in handling hazardous materials to be quickly trained and utilized, there will be a high potential for cutting corners resulting in additional risk to both the workers and the public. The “Air Monitoring and Contingency Plan for Hurricane Katrina Debris Activities Louisiana” calls for 3 sets of air monitoring systems with sampling at two burn sites per day and one “floater” system to be available as needed. The key is then to keep that floater system in action so any other non-monitored burn site could be monitored without notice and let all of the contractors doing the demolition and burning know that they could be monitored at any time with penalties if they fail to comply with the guidelines and procedures. There must be a rigorous QA process to ensure that everyone is doing the demolition and combustion in the best possible manner if public and worker health is to be protected while dealing with this large quantity of debris. (Hopke)

Most of the parameters described will be adequate, but there is no mention of others that might also be important. These are:
* Consideration of prevailing winds to ensure that effluents do not go toward populated areas.

* Control of re-suspension of burn ash during removal from burn pit, loading onto trucks, truck transport to disposal sites, and discharge into such disposal sites. (Lippmann)

There is a wide range of parameters that will be used to monitor the emissions of contaminants to the atmosphere and to the bottom ash. However, it is unclear how representative the samples will be and how the results will be included in a contingency plan in case there are conditions that are a danger to human health and the environment. It is not clear how the results will be used to assess if the air curtain pit burns are burning the wastes safely. (Rood)

Remote sensing of the plumes that integrate results across the entire plume should be carefully considered for the initial test burns. The plumes will most likely be very heterogeneous temporally and spatially, which will make it difficult for extractive point samplers to provide representative samples that describe the composition and concentration of contaminants in the plume. (Rood)

Charge Question 3. Pollutants to be measured: Given the broad range of compounds likely to be present in open burning of demolition debris, do the specific compounds listed describe an adequate range of pollutants to provide guidance on the performance of open burning systems?

The source monitoring and ambient air hit lists of pollutants are not in agreement. Hexachlorobenzene should be added as a surrogate for chlorinated hydrocarbons. Vinyl chloride should be added to the source test. (Dellinger)

Dioxins will be formed and must be added to the testing. Much of the debris will be contaminated with salt water. An organic fuel, chlorine from the salt, transition metals from construction and other sources, and poor combustion conditions are the recipe for forming dioxins. I doubt if open burning can satisfy any serious evaluation of its human health impacts. (Dellinger)

Biomass combustion will produce large quantities of catechols and phenols that are now strongly implicated in initiation of oxidative stress in individuals exposed to airborne fine particles. Catechol and hydroquinone are also 2 of the 3 most toxic chemicals in cigarette smoke. These classes of compounds must be added along with analysis of associated free radicals. (Dellinger)

Maybe include opacity as a combustor efficiency indicator? (Eighmy)

The pollutants cited are adequate in terms of being of concern by themselves, and/or as surrogates of others. (Lippmann)

The lists of specific compounds provided in the appendices are relevant to characterizing the emissions from open curtain pit burning of the wastes. However, the documentation

could be strengthened if it describes how the information will be interpreted, and used to decide how best to operate the air curtain pit burns. (Rood)

Charge Question 4. Burn site monitoring – continuous monitoring or characterization monitoring: Is it sufficient to monitor an initial burn(s) to develop a characterization of potential releases rather than continuously monitoring each burn? How many burns should be monitored to develop the initial characterization necessary to determine the appropriate parameters?

The idea of doing some initial studies and figuring out what is working and what is not might be a better approach than wide spread continuous emission monitoring of all burner type/waste combinations on a routine basis over time. (Eighmy)

As noted above, the initial 36 trials may be unnecessarily extensive and expensive. Some initial framing of the approach (waste type and combustor type) is needed. Building in flexibility to the approach allows for subsequent testing programs to get additional needed information as lessons are learned. (Eighmy)

Are there really sufficient laboratory capabilities to handle the workload? For example, there is a requirement to handle sites containing PCBs differently. Is the capability for making those determinations in place? (Hopke)

It is prudent to monitor the plumes of all operating pit burns because of the heterogeneity of the wastes to be burned and the degree of control that exists with the open curtain pit burns. Parameters should include at least CO, temperature, and particulate mass concentration/opacity. Results from the measurements need to be interpreted and then provided to the certified/trained (?) open pit burn operators. (Rood)

Charge Question 5. Monitoring methods, equipment, and quality assurance activities: To the extent that EPA has been able to describe or reference the monitoring methods, equipment, and quality assurance activities in the document, are they appropriate? What advice do you have for EPA as we further develop the methods and equipment plans?

There appears to be no plan for conducting a test burn. This must be done first. There is no stated plan as how to determine if a burn is safe, either during the actual burn or during a test burn. Burning rates and temperatures will vary widely making plume dispersion and trajectory modeling exceedingly difficult. (Dellinger)

Perhaps the state-of-the-art has changed, but given the different ways that combustor gases were sampled in the Lutes and Kariher (1997) study and the Fountainhead Engineering Study (2000) and the problems posed about sampling hot gases over an ACD, the type of slip stream samplers/impactors used, and the difficulties in thermal measurements of the fuel beds, flexibility in how the air emission studies are crafted might be helpful. This may have to be a “learn as you go” exercise. (Eighmy)

It is planned to measure particulate mercury, but the bigger problem will be the release of reactive gaseous mercury (RGM) that can more readily deposit and start to cycle in local ecosystems. It would be very useful to get some Tekran continuous RGM units into the mix of monitors to explore the potential for RGM release from the demolition/combustion activities. (Hopke)

No Guidelines were offered as to acceptable levels of concentrations or lower limits of detection. Lacking these, there it is not possible to judge whether the methods and equipment are appropriate. The QA does seem to be appropriate. (Lippmann)

Although the EPA conditions document indicates monitoring for polychlorinated dioxins and dibenzofurans, the Air Monitoring and Contingency Plan for Hurricane Katrina Debris Activities Louisiana suggests mostly low volume sampling that is unlikely to provide a sufficient sized sample to permit accurate assessment of the PCDDs and PCDFs. There needs to be sampling specifically established for these contaminants and it is not clear where that is in the material provided to us. (Hopke)

The Air Monitoring and Contingency Plan for Hurricane Katrina Debris Activities Louisiana proposes using ICP for the metals determinations. However, the digestion and analysis is somewhat slow and it may make sense to do some screening with more rapid XRF analyses to find quickly if there are problems with high metal levels. (Hopke)

Sorting of the wastes for the test burns needs to be completed carefully to best represent the wastes as they will be burned at other test sites. Select continuous monitors should be used at all burn sites to provide feedback to the operators about when and how to feed and mix wastes in the combustion zones. (Rood)

Submitted Written Comments from Panel as of 10/4/05

- Dr. H. Barry Dellinger
- Dr. Taylor Eighmy
- Dr. Philip K. Hopke
- Dr. Morton Lippmann
- Dr. Mark Rood

Dr. H. Barry Dellinger:

1. Open burning issues of concern

The approach identifies several issues of concern associated with open burning:

Failure of asbestos to be transformed into benign forms
Emissions of metals, particularly lead and mercury
Formation of halogenated organic compounds
Increased emissions of PM, including $PM_{2.5}$

I have serious reserves concerning the use of open burning for cleanup of hurricane-related debris. Open burning does not effectively destroy existing toxic chemicals, and it forms new toxic chemicals. Biomass combustion emissions are not that different than emissions from smoking a cigarette except that they do not contain high levels of nicotine.

The volumes to be burned are enormous and the combustion control is poor. Emissions will likely be overwhelmingly larger than from existing municipal or hazardous waste incinerators in the US. Incinerators have been largely eliminated as a result of public concern, and they are much better controlled than open burning. Is there any real data to suggest that air curtain burning is any better?

There is a lot of support for coastal restoration in Louisiana. Can the debris be used for this purpose? If transport of Formosan termites is a concern, the debris could first be treated then transported.

Transporting the debris to "rural" areas brings up environmental justice concerns. The inhabitants of the rural areas did not generate the debris, so why should they be exposed? Even if the population density is lower in a rural area, exposed people are still exposed to the full dose of pollution. Either burn the debris in place while no one is still in New Orleans, burn it on the coast while the winds blow into the Gulf, or better yet, burn it in an incinerator.

Are these the situations that should most receive attention?

2. Parameters to be monitored

Are the parameters that are described adequate for developing operating guidance to ensure that future open burning activities are conducted in such a way to minimize adverse impacts on human health and the environment?

It is not clear that a test burn to determine safety is being proposed. It appears that all the monitoring is to be conducted while the actual burn is being conducted. I strongly

recommend a well documented and monitored test burn be conducted and evaluated before actual burns are conducted.

Open burning is impossible to control. Temperature measurements will have little meaning as the temperature will vary widely. Toxic chemicals will be vaporized ahead of an advancing flame front and may be vaporized rather than burned. The burn guidelines state that a minimum temperature of 800 C must be maintained. This is very low and will not destroy most chemicals under sub-stoichiometric combustion conditions. Normal temperature fluctuations will result in the temperature being too low to destroy most toxic chemicals even under oxidative conditions.

3. Pollutants to be measured

Given the broad range of compounds likely to be present in open burning of demolition debris, do the specific compounds listed describe an adequate range of pollutants to provide guidance on the performance of open burning systems?

The source monitoring and ambient air hit lists of pollutants are not in agreement. Hexachlorobenzene should be added as a surrogate for chlorinated hydrocarbons. Vinyl chloride should be added to the source test.

Dioxins will be formed and must be added to the testing. Much of the debris will be contaminated with salt water. An organic fuel, chlorine from the salt, transition metals from construction and other sources, and poor combustion conditions are the recipe for forming dioxins. I doubt if open burning can satisfy any serious evaluation of its human health impacts.

Biomass combustion will produce large quantities of catechols and phenols that are now strongly implicated in initiation of oxidative stress in individuals exposed to airborne fine particles. Catechol and hydroquinone are also 2 of the 3 most toxic chemicals in cigarette smoke. These classes of compounds must be added along with analysis of associated free radicals.

4. Monitoring methods, equipment, and quality assurance activities

To the extent that EPA has been able to describe or reference the monitoring methods, equipment, and quality assurance activities in the document, are they appropriate? What advice do you have for EPA as we further develop the methods and equipment plans?

There appears to be no plan for conducting a test burn. This must be done first. There is no stated plan as how to determine if a burn is safe, either during the actual burn or during a test burn. Burning rates and temperatures will vary widely making plume dispersion and trajectory modeling exceedingly difficult.

Dr. Taylor Eighmy:

Documents Reviewed:

1. Charge Questions for SAB Workgroup Consultation on Approach for Conducting Source Emission Characterization Tests of Open Burning of Vegetative and Demolition Debris (10/3/05 version).
2. EPA's Conditions for Granting a No Action Assurance and Associated Recommendations for LDEQ Asbestos Demolition and Disposal Procedures for Jefferson Parish, Orleans Parish, Plaquemines Parish and St. Bernard Parish in the Aftermath of Hurricane Katrina and Hurricane Rita (10/3/05 draft).
3. Appendix A to Document 2: Hurricane Katrina Debris Management Plan, Louisiana Department of Environmental Quality, September 28, 2005, Revised September 30, 2005.
4. Appendix B to Document 2: Approach for Conducting Source Emission Characterization Tests of Open Burning of Vegetative and Demolition Debris.
5. Appendix C to Document 2: Air Monitoring Contingency Plan for Hurricane Katrina Debris Activities Louisiana (September 2005).
6. Appendix D to Document 2: Overview Plan for Ambient Air Monitoring after Hurricane Katrina.
7. Letter of September 22, 2005 from LDEQ to Region 6.

Background:

The Gulf Coast region (especially the City of New Orleans and surrounding parishes) is facing an immense debris management problem associated with Hurricanes Katrina and Rita. The debris has both imminent and longer term safety and health hazards and its presence prevents necessary reconstruction efforts.

In essence, the U.S. EPA is attempting to develop a quickly implemented research plan to assess the performance of open burning of various debris types (using open piles, pit air curtain destructors, firebox air curtain destructors) as the State of Louisiana and the Regional EPA offices wrestle with the very real issue of managing enormous quantities of vegetative and building debris.

One preferred management strategy, referred to as generally as open burning (but perhaps really variations of air curtain destructors) may be an excellent way to quickly reduce debris volume, destroy sources of the Formosan termite, and render the debris more inert. However, uncontrolled combustion can lead to another suite of environmental problems associated with uncontrolled combustion. While desiring to assist, the U.S. EPA does not want to exacerbate the situation by tacitly approving a well-intentioned management strategy that inadvertently leads to additional environmental problems.

Overview Comments:

1. I am a bit confused: I see in the September 22nd letter from LDEQ that the state intends to use combustion as one means of disposal, including air curtain destructors (ACDs). ACDs will apparently not be exclusively used. In the Conditions and Recommendations document, conditions for granting a no action assurance are limited to the use of ACDs (but not differentiating between pit ACDs and firebox ACDs) for building debris waste. In Appendix B, differentiation is made about testing firebox ACDs, pit ACDs and open burn piles.

Recommendation: Clarify, where applicable, the use of firebox ACDs, pit ACDs and open pile burns.

2. Perhaps related to the first comment, it is not clear if open burn piles will be used for vegetative debris and ACDs for building debris. Clarity may be important here as this has bearing on how asbestos, Pb, Hg, PM, and organohalogens might be emitted from combustion processes, and how air emission and residuals sampling and testing programs are undertaken. From afar, my first reaction is that open pile burning, if done at all, should be limited to vegetative wastes only.

Recommendation: Clarify how open pile burning and ACDs will be generally used.

3. At this juncture, it seems to me that there is not a lot of scientific information on air emission monitoring and ash residuals testing from ACDs, though I note at least two perhaps useful studies that may help with air emission sampling problems/solutions and perhaps expected emission data:

- Lutes, C.C. and P.H. Kariher (1997) Evaluation of Emissions from the Open Burning of Land Clearing Debris, EPA/600/SR-96/128, U.S. EPA NRL, January, 1997.

- Fountainhead Engineering (2000) Final Report Describing Particulate and Carbon Monoxide Emissions from the Whitton S-127 Air Curtain Destructor.

Recommendation: If appropriate, EPA and LDEQ might make use of sampling methodologies and device configurations in these documents as sampling plans are finalized.

4. It seems to me, based on information in Appendix B; an outline to an approach is offered to develop the information needed to create effective and credible guidelines for open burning disposal of asbestos-contaminated demolition debris as well as for other materials that are likely to be disposed of via open burning. Once information is learned, the approach will be memorialized. The approach also will need flexibility as it is implemented and lessons are quickly learned.

What this approach is really trying to do is describe practical waste type and combustor conditions where air and residual emissions are acceptable with respect to human health and environmental risk.

The approach involves doing sampling runs in triplicate for three combustor types (open pile, pit ACD, fire box ACD) using four waste types (vegetative, vegetative plus demolition, demolition of composition A and demolition of composition B). I think this approach is very sound as the EPA and LDEQ seek to frame the relative risks and benefits for managing the various debris types by combustion process type.

However, this will produce 36 sampling campaigns, a rather extensive and expensive program. The documents, as provided, do not explicitly lay out a designed test burn/residuals sampling program for these 36 campaigns that will get to the over arching issues of balancing relative risks to human health and the environment. The type of burning technologies used will play a large role. The transient nature of the burner process will play a large role. Waste composition will play a large role. Ongoing ACD operations (and operators) will play a large role.

Recommendation: Simplify the program by restricting the burning of building debris to only pit ACDs and firebox ACDs.

Recommendation: Simplify the program by doing duplicates initially. You can always go back and add to the program later once more information is available. It is going to be tough to even make the duplicates truly duplicate in nature.

Recommendation: Simplify the program by doing using only one type of composite demolition waste initially. You can always go back and add to the program later once more information is available.

Recommendation: Give some thought to designing a subsequent side study that looks at ACD operation (bed layering, percent over fire air, transient emissions when debris is charged and the curtain is temporarily breeched) once initial information is obtained.

Charge Question 1. Open burning issues of concern: The approach identifies several issues of concern associated with open burning: Failure of asbestos to be transformed into benign forms, Emissions of metals, particularly lead and mercury; Formation of halogenated organic compounds, and Increased emissions of PM, including PM2.5 --- Are these the situations that should most receive attention?

Recommendation: This is a good list to start with and includes contaminants of concern. I wonder how easy it will be to relate burner type and waste type to something like standardized emissions or emission factors for these materials.

Recommendation: There is some literature on the dehydroxylation of chrysotile to forsterite at temperatures above 800^{o}C and at ambient pressure (e.g., MacKenzie and Meinhold (1994) Amer. Mineral. 79:43-50, Jeyaratnam and West (1994) Ann. Occupational Hygiene 32: 137-148). There is less know about the kinetics of the reaction, though one source reports the reaction is fast. The time/temperature/turbulence conditions in the ACDs are not well known and the ability to sample for flue gas particles that may

contain chrysotile or its thermal degradation products is important. Likewise, sampling the bottom ash would also be important. Depending on the type of waste burned and the asbestos level, finding particles may be like finding needles in a haystack. Consider some additional bulk techniques as a screen first (especially x-ray diffraction). The TEM technique can then be made easier to use if you can concentrate the chrysotile/forsterite samples through some technique (perhaps washing, density gradient separation, magnetic separation).

Charge Question 2. Parameters to be monitored: Are the parameters that are described adequate for developing operating guidance to ensure that future open burning activities are conducted in such a way to minimize adverse impacts on human health and the environment?

Yes, it is a good place to start. However, when attempting to frame relative emissions, some efforts will have to put into emission factor determination as a function of waste burned or as a function of combustion conditions (% O_2, CO, CO_2) so that comparisons can be made. These observations are for only steady state situations. This does not include transient operations.

Recommendation: The air emission and residual sampling campaign must be made as uniform and standardized as possible across the range of waste combusted and combustor types. That will require some knowledge of the fuel, the combustor air provision (where possible) and combustor burn performance (% O_2, CO, CO_2). This is not simple given the notion of sampling an open burning pile, unconfined combustion generally even in an ACD, and the spatial-temporal nature of the combustion flame even in an ACD.

Recommendation: Most ACDs have somewhat steady state operations intermixed with transient loadings that can breech the air curtain. Some understanding of what is emitted during breech events may eventually be helpful.

Charge Question 3. Pollutants to be measured: Given the broad range of compounds likely to be present in open burning of demolition debris, do the specific compounds listed describe an adequate range of pollutants to provide guidance on the performance of open burning systems?

Recommendation: Maybe include opacity as a combustor efficiency indicator?

Charge Question 4. Burn site monitoring – continuous monitoring or characterization monitoring: Is it sufficient to monitor an initial burn(s) to develop a characterization of potential releases rather than continuously monitoring each burn? How many burns should be monitored to develop the initial characterization necessary to determine the appropriate parameters?

Recommendation: The idea of doing some initial studies and figuring out what is working and what is not might be a better approach than wide spread continuous emission monitoring of all burner type/waste combinations on a routine basis over time.

Recommendation: As noted above, the initial 36 trials may be unnecessarily extensive and expensive. Some initial framing of the approach (waste type and combustor type) is needed. Building in flexibility to the approach allows for subsequent testing programs to get additional needed information as lessons are learned.

Charge Question 5. Monitoring methods, equipment, and quality assurance activities: To the extent that EPA has been able to describe or reference the monitoring methods, equipment, and quality assurance activities in the document, are they appropriate? What advice do you have for EPA as we further develop the methods and equipment plans?

Recommendation: Perhaps the state-of-the-art has changed, but given the different ways that combustor gases were sampled in the Lutes and Kariher (1997) study and the Fountainhead Engineering Study (2000) and the problems posed about sampling hot gases over an ACD, the type of slip stream samplers/impactors used, and the difficulties in thermal measurements of the fuel beds, flexibility in how the air emission studies are crafted might be helpful. This may have to be a “learn as you go” exercise.

Dr. Philip K. Hopke:

My major concern is the potential differences between the operation of systems in test burns and demonstration combustion projects and mass production efforts. It is one thing to set up the air curtain combustor when you know you are being watched with a careful monitoring effort. It is quite possible to be less careful when you are combusting material day-after-day-after-day on different sites and with different mixes of input materials. It is not clear from the documents what the continuing level of oversight and monitoring. Given the staggering amount of material to be inspected and disposed of, there will need to be a large number of monitoring and oversight personnel assigned to ensure that the procedures are being followed each and every time and that the ACD is being properly used as it is moved on a frequent basis.

The procedures outlined seem very reasonable, but it is of great concern that in a mass production operation that will require the use of far more people than currently have experience in handling hazardous materials to be quickly trained and utilized, there will be a high potential for cutting corners resulting in additional risk to both the workers and the public. The "Air Monitoring and Contingency Plan for Hurricane Katrina Debris Activities Louisiana" calls for 3 sets of air monitoring systems with sampling at two burn sites per day and one "floater" system to be available as needed. The key is then to keep that floater system in action so any other non-monitored burn site could be monitored without notice and let all of the contractors doing the demolition and burning know that they could be monitored at any time with penalties if they fail to comply with the guidelines and procedures. There must be a rigorous QA process to ensure that everyone is doing the demolition and combustion in the best possible manner if public and worker health is to be protected while dealing with this large quantity of debris.

Are there really sufficient laboratory capabilities to handle the workload? For example, there is a requirement to handle sites containing PCBs differently. Is the capability for making those determinations in place?

Given the highly heterogeneous nature of the materials being burned, I would worry about the uniformity of temperature and thus, would not assume that all of the chrysolite will be converted into forsterite. Although the guidelines call for the mean temperature to remain above 800C, it is certainly possible to have areas that do not consistently meet that temperature while other regions are higher. Thus, the assumption should be made that there will remain chrysolite in the debris.

It is planned to measure particulate mercury, but the bigger problem will be the release of reactive gaseous mercury (RGM) that can more readily deposit and start to cycle in local ecosystems. It would be very useful to get some Tekran continuous RGM units into the mix of monitors to explore the potential for RGM release from the demolition/combustion activities.

Although the EPA conditions document indicates monitoring for polychlorinated dioxins and dibenzofurans, the Air Monitoring and Contingency Plan for Hurricane Katrina

Debris Activities Louisiana suggests mostly low volume sampling that is unlikely to provide a sufficient sized sample to permit accurate assessment of the PCDDs and PCDFs. There needs to be sampling specifically established for these contaminants and it is not clear where that is in the material provided to us.

The Air Monitoring and Contingency Plan for Hurricane Katrina Debris Activities Louisiana proposes using ICP for the metals determinations. However, the digestion and analysis is somewhat slow and it may make sense to do some screening with more rapid XRF analyses to find quickly if there are problems with high metal levels.

Dr. Morton Lippmann:

1) Issues of Concern

Issues of concern that should receive as much, or more concern than the four ones listed are:

* mold spore dispersion and worker exposures in handling waste construction debris
* are wastes sufficiently segregated prior to combustion
* how will burn temperature be maintained when burning construction debris in view of non-combustibles and varying moisture content?
* how will burn temperature be maintained when burning vegetative debris in view of varying moisture content?
* will the burn temperature be optimal or nearly so for minimizing the formation of halogenated organic compounds?
* will air quality data from early burns be available in time to influence protocols for subsequent burns? The asbestos issue is broader than the thermal conversion of chrysotile to forsterite. The protocols fail to address the possible presence of more the hazardous amphibole fibers. Also the analytical protocols indicate that AHERA counting rules would be used, which will ensure that the fiber counts are dominated by fibers shorter than 5 um, which pose negligible risks.

2) Parameters to be Monitored

Most of the parameters described will be adequate, but there is no mention of others that might also be important. These are:
* Consideration of prevailing winds to ensure that effluents do not go toward populated areas.
* Control of re-suspension of burn ash during removal from burn pit, loading onto trucks, truck transport to disposal sites, and discharge into such disposal sites.

3) Pollutants to be Measured

The pollutants cited are adequate in terms of being of concern by themselves, and/or as surrogates of others.

4) Monitoring Methods, Equipment, and QA

No Guidelines were offered as to acceptable levels of concentrations or lower limits of detection. Lacking these, there it is not possible to judge whether the methods and equipment are appropriate. The QA does seem to be appropriate.

Dr. Mark Rood:

1. Open burning issues of concern

The heterogeneity of the waste's heat content and composition and the heterogeneity of the burning conditions are more diverse in the air curtain pit burners than exists for municipal solid waste incinerators. Care needs to be taken by the operators to provide adequate mixing of the wastes to achieve a more uniform temperature and reasonable circulation of combustion air. A wide range of contaminants is proposed to be monitored, but it is unclear how well the results will characterize the bottom ash, fly ash, and gaseous emissions. It would be good to consider how the monitoring results will provide feedback to the community and to the personnel operating the burn site. The documentation should also provide guidelines about when to burn that are based on meteorological conditions (e.g. existence of low lying inversion layers, wind direction/speed, and select atmospheric stability conditions). Dispersion modeling scenarios should be considered to provide the operators the best conditions to complete the burns.

The documentation takes into special consideration: 1) asbestos, 2) metals, particularly lead and mercury, 3) halogenated organic compounds, and 4) PM, including PM2.5. However inorganic gases such as HCl and CO should be carefully monitored to characterize acid gas emissions and incomplete combustion. Production of these contaminants during stable atmospheric conditions could prove problematic for nearby burn pit operators and communities.

2. Parameters to be monitored

There is a wide range of parameters that will be used to monitor the emissions of contaminants to the atmosphere and to the bottom ash. However, it is unclear how representative the samples will be and how the results will be included in a contingency plan in case there are conditions that are a danger to human health and the environment. It is not clear how the results will be used to assess if the air curtain pit burns are burning the wastes safely.

Remote sensing of the plumes that integrate results across the entire plume should be carefully considered for the initial test burns. The plumes will most likely be very heterogeneous temporally and spatially, which will make it difficult for extractive point samplers to provide representative samples that describe the composition and concentration of contaminants in the plume.

3. Pollutants to be measured

The lists of specific compounds provided in the appendices are relevant to characterizing the emissions from open curtain pit burning of the wastes. However, the documentation could be strengthened if it describes how the information will be interpreted, and used to decide how best to operate the air curtain pit burns.

4. Burn site monitoring – continuous monitoring or characterization monitoring

It is prudent to monitor the plumes of all operating pit burns because of the heterogeneity of the wastes to be burned and the degree of control that exists with the open curtain pit burns. Parameters should include at least CO, temperature, and particulate mass concentration/opacity. Results from the measurements need to be interpreted and then provided to the certified/trained (?) open pit burn operators.

5. Monitoring methods, equipment, and quality assurance activities

Sorting of the wastes for the test burns needs to be completed carefully to best represent the wastes as they will be burned at other test sites. Select continuous monitors should be used at all burn sites to provide feedback to the operators about when and how to feed and mix wastes in the combustion zones.